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VALLEY OF THE DINOSAURS

Prepared by DR. W. R. READ



A visitor approaching the city of Drumheller is suddenly confronted by a mile wide valley where the Red Deer river has excavated below the prairies of Central Alberta to a depth of nearly four hundred feet. Travelling from Calgary via No. 9 Highway the first intimation of an abrupt change in terrain occurs at Horseshoe canyon lookout ten miles south-west of the city of Drumheller. Horseshoe Canyon is only tributary to the Red Deer valley and the scenery here is but a preview of the magnificent vistas that await in the main canyon between Drumheller and Trochu ferry. The grandeur of the multi-colored, sculptured walls of the valley, as viewed from the Dinosaur trail between Drumheller and Munson ferry, is unexcelled elsewhere in Canada. Here are the world famous Badlands of Alberta.

The Red Deer Valley is the result of erosion. The Red Deer river has required only a few thousand years to carve the badlands, but in the process it has revealed a chapter in the history of the earth that was written in the rocks seventy-five million years ago and when deciphered by geologists rivals the best of science fiction.

FOSSILS LIFT THE VEIL OF TIME

Life on our earth has passed through many stages between its birth in the remote past and its present day expression. Great races of creatures arose and flourished for many millions of years and became extinct leaving only their remains as mute evidence of their existence. These remains are called fossils and they comprise bones and tracks of ancient animals, as well as impressions of leaves and petrified wood buried in the rock of the earth's crust.

Although fossil remains were known to exist as early as 450 B.C., for many centuries they were deprecated as devices planted by the devil to delude man. Another conviction held was that fossils were "relics of that accursed race that perished with the flood." But by the turn of the 19th century a few pioneer students of the earth, geologists (the early geologists were more stone masons than scientists) noticed that a relationship existed between certain layers of rocks and the fossils which they contained. Each layer seemed to have its own characteristic plant and animal remains. These men began to sense dimly vast expanses of time punctuated here and there by profound changes in life, topography and climate. Slowly they began to piece together the petrified bits and pieces into a picture of the life of millions of years ago. Thus was born the science of paleontology, the study of ancient life. Paleontology is an adjunct of geology, the broader science that investigates the structure and history of the earth and in a practical way discovers and exploits all kinds of economic mineral resources including oil, coal, iron and gold and so on.

There are many things of interest in the Red Deer valley for the geologist. For the paleontologist the badlands are a veritable storehouse of fossils which is easily accessible to the amateur fossil hunter as well as the professional collector. A few hours spent exploring the coulees of the valley will prove stimulating and rewarding to anyone who follows the dinosaur trail and visits the local museum.

This earth is perhaps three billion years old. So far as paleontologists can tell the first living things appeared on earth about two billion years ago. For a long time after that, possibly one and a half billion years the only animals were relatively insignificant creatures such as sponges, jellyfish, snails, clams, worms and crab-like beasts, but no animals with back-bones appeared until about four hundred million years ago. These first animals with back-bones were the fishes which were soon followed by creatures that could breathe air and spend part of their lives out of the water, in other words: amphibians, whose living descendants are the frogs, turtles and salamanders. A little later some amphibians became entirely divorced from their life in the water, developed dry, scaly skins and thus became the first reptiles.

The reptiles soon dominated the land and ushered in the Age of Reptiles. This age is known technically as the Mesozoic Era and lasted about 130 million years. It came to a close about 65 million years ago with the final extinction.

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tion of the great dinosaur and most of their lesser allies. Of the reptiles only the turtles, lizards, snakes, crocodiles and the tuatara have survived to modern times. The Age of Mammals in which we live followed the demise of the dinosaurs. The great Ice Age, of which we speak so glibly in terms of long ago, in fact occurred within the last million years and according to some is still with us.

Where in this long history do the rocks in the Red Deer valley fit and how did they come to be?

GEOLOGY

The most abundant rocks in the valley walls are composed of alternate bands of black, brown, grey and white layers of coal, clay, ironstone, shale and sandstone. These rocks are called the Edmonton formation by geologists and the fossils they contain tell us that they date from near the end of the Age of Reptiles, a time known to geologists as the Cretaceous Period. In a few places light grey yellow cliffs can be seen above the darker coloured Edmonton rocks and these belong to the Paskapoo formation which was laid down some 60-65 million years ago at the beginning of the Age of Mammals. Still higher in the bluffs, right up to the prairie's edge and "on top" are yellow gravels, sand and silts which date from sometime in the great Ice Age or Pleistocene Epoch. These sediments are only a few thousand years old and evidently formed in lakes that lay upon the land when the broad glaciers were melting away. The regularly banded yellow silts which can be seen along the highway as it begins its descent towards Drumheller were deposited in old Lake Drumheller which is estimated to have covered an area of approximately eleven hundred square miles. Lake Drumheller was dammed by glacial ice that melted more slowly to the south, but when the ice dam finally disappeared the old lake was drained and the final sculpturing of the Red Deer Valley commenced. This occurred only a few thousand years ago. The rim of hills at the prairie level are composed of sand and gravel that was dumped from glacial streams as the melting ice caused their channels to collapse.

What occurred between the end of the Age of Reptiles and the Ice Age is little known in the Drumheller district. Sediments probably continued to be deposited here off and on for the 65 million years of the Age of Mammals, but the glaciers so gouged the surface of the earth that they carried away mile after mile of more recent rocks. Thus was destroyed most of the record in the rocks except those from the very earliest times in the Age of Mammals, which are still preserved in the Paskapoo formation.

THE EDMONTON FORMATION

The colourfully banded layers of the Edmonton formation were deposited by meandering rivers in shallow lakes and lagoons and flood plains. Layer upon layer of mud, clay, silt and sand piled up over thousands of years to a depth of hundreds of feet. In the ensuing millions of years these sediments

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were cemented and compacted into the hard rocks they are today.

It is a distinctive feature of these rocks that they contain large quantities of the mineral bentonite which is derived from the chemical weathering of volcanic ash. At times, thin but very extensive layers of white volcanish ash were apparently deposited directly in shallow bodies of water covering much of the Central Alberta and Saskatchewan region. This material called the Kneehills tuff in the Drumheller area is very hard and forms a thin white "cap rock" at the rim of Horseshoe canyon. According to geologists the ash itself was evidently spewed out of volcanoes which erupted to the south in what is now the state of Montana.

Most of the sand and mud that forms the Edmonton formation was derived from the erosion of highlands to the west. The Rocky Mountains had begun to rise in the closing phases of the Mesozoic Era (Age of Reptiles) under the influence of what seems an almost unimaginable warping of the American continent. Off and on for hundreds of millions of years a vast inland seaway had joined the Gulf of Mexico and the Arctic Ocean across what now are the prairie states and provinces. Some deposits from this arm of the sea called the Bearpaw formation can be seen south-east of Drumheller where brown shales form the base of the stems of the Hoodoos at Willow Creek. Fossil oyster shells in the Edmonton formation are apparently derived from this inland sea which briefly inundated some of the lowlands at several times during deposition of the Edmonton sediments.

At the very end of the Age of Reptiles the warping of the continent combined with erosion to cause the final retreat of this great seaway from North America. By this time the last of the Edmonton rocks had been deposited.

The Edmonton formation is of great interest because of the wealth of dinosaur bones which it contains. But dinosaurs are not the only fossils in these rocks. Also present are remains of various less spectacular creatures including sharks, alligators, gars and other fishes, salamanders, turtles, lizards, crocodiles and an almost unbelievable sea-monster called a plesiosaur. At several places there are layers of ancient oyster shells and besides coal deposits there are remain of a great variety of plants and petrified tree trunks.

ALBERTA 70 MILLION YEARS AGO

Scientific analysis of the geological and paleontological evidence afforded by the Edmonton formation and its fossils permits the following impressions of what Alberta was like some 70 million years ago.

Where flat prairie land now rises gradually toward the ancient Rocky Mountains a broad swampy delta formed along the edges of the inland sea that stretched north-westward from the Gulf of Mexico. Where the Red Deer river now cuts its canyon there were then broad and meandering streams with backwaters bordering on the stagnant, which in places produced swamps where vegetation decayed in the first stages of coal formation. These lowlands were periodically flooded and occasionally for several years at a time the sea drowned some of the river mouths. Wide savannas reached inland onto higher ground.

Where now temperatures range from 110 degrees above zero to 50 degrees below and the countryside is swept unmercifully by winter blizzards, the climate was then uniformly sub-tropical and the ground never froze in the winter. Where now trees worthy of the name exist only in sequestered places, then there lived a "forest primeval" composed of tall redwoods, cypresses, sable palms, plane trees, gingkos and others that today occur only in subtropical climates.

In this setting instead of herds of cattle, sheep and occasional families of antelope there lived hordes of armoured and duck-billed dinosaurs. The variety of these creatures is almost beyond imagination. Armoured dinosaurs resembling horned toads as big as trucks moved sluggishly about the countryside. Fleeter dinosaurs the size of ostriches ran about on long hind legs in search of seeds, flies, insects or perhaps eggs. Always in the background lurked the possibility of sudden crushing death administered by gigantic carverous

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dinosaurs which were among the most devastating destroyers nature has ever devised. Streams and Lakes were populated, in addition to the ubiquitous duck-bill dinosaurs, by crocodiles, turtles and fishes, many of which were possibly indistinguishable from their descendants in the present day everglades. And in the trees or wherever else protection could be had from the fearsome brutes of the reptile world, there lived the tiny possum-like creatures, "the advance guard" of the furry minions destined a few million years hence, to inherit the world.

DINOSAUR DISCOVERIES

The most famous petrified remains found in the Drumheller Badlands are the dinosaur bones. While one may find abundant petrified wood, fossil shells, berries, cones and even whole beds of fossil oysters, it is the dinosaur remains that have made the area famous among paleontologists the world over.

In the summer of 1884, Dr. J. B. Tyrrell was dispatched by the Dominion Geological Survey to investigate reported occurrences of coal in the Red Deer river valley. While thus engaged he discovered the head of a petrified monster exposed in a hillside near Kneehill Creek. Dr. Tyrrell sent this and other specimens to Ottawa and Philadelphia for study, and as is usual in scientific research the results of the study were not published until several years afterwards. In 1897 the Drumheller district was visited by a paleontologist, Mr. Lawrence M. Lambe, of the Geological Survey of Canada. In 1910, Barnum Brown of the American Museum of Natural History of New York led the first organized expedition for dinosaurs into the valley between the Trochu ferry and the city of Drumheller. He returned in 1911 and in 1912 to complete his work in the Edmonton formation, and in the three years collected an exceptionally fine series of dinosaur skeletons and skulls. In 1912 also, the world famous fossil hunter, Mr. Charles H. Sternberg explored the area accompanied by his sons, Levi, Charles M. and George. On August 12th of that year, Charles M. Sternberg discovered a large duck-billed dinosaur skeleton on Michichi Creek which was later assembled at the National Museum in Ottawa and became the first dinosaur skeleton to be mounted in a Canadian museum. Although C. H. Sternberg continued to search for dinosaurs in the Canada fossil fields for several years, he never returned to the Drumheller district. His three sons, however, conducted no less than thirteen expeditions in the general vicinity of Drumheller, Munson, Morrin, Trochu and Ardley. By far the most frequent visitor to the district was Dr. Charles M. Sternberg who between 1923 and 1947, conducted six expeditions into the valley on behalf of the National Museum of Canada.

As recently as 1955-56 a dinosaur skeleton was excavated by the National Museum of Canada near Munson ferry and although the specimens are perhaps less easily discovered now than in earlier years, there is no evidence that the supply of fossils in the valley is becoming exhausted.

Since the first discoveries were made three quarters of a century ago nearly thirty fairly complete dinosaur skeletons have been obtained from the Red Deer Valley north of Drumheller. Many of these were new to science and have been duly recorded in technical literature that runs to many hundreds of pages.

The best collection of dinosaur skeletons and skulls from the Drumheller district may be seen in the Royal Ontario Museum in Toronto, the American Museum of Natural History in New York and the National Museum of Canada in Ottawa. Skulls and partial skeletons of other "Drumheller" dinosaurs are preserved in the Chicago Natural History Museum, the British Museum of Natural History in London, and in several North American and European university collections.

DINOSAURS

Cold stone fossil beds tell us nearly all we know about the dinosaurs. These extinct reptiles however, were once the dominant wild animals throughout about 130 million years of earth history. The last of them died perhaps 65 million years ago when the warm blooded mammals finally inherited the earth.

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The first dinosaurs evolved from small alligator like beasts some 200 million years ago. At first, the dinosaurs were small slender bodied animals quite different from the gigantic behemoths of later times. The first dinosaurs were probably flesh eating animals, but eventually some of these became more omnivorous in diet and later some of these became specialized to an herbivorous diet. The first dinosaurs were evidently bipedal animals, but when as a group they became heavier of body they tended to walk on all fours as their distant ancestors have done. A few dinosaurs, both of the herbivorous and carnivorous kinds, later became bipedal again; in fact it is not certain that the carnivorous dinosaurs ever passed through a completely quadrupedal stage in their evolution.

During the Age of Reptiles, the dinosaurs and their allies managed to become fitted for making a living in almost every conceivable fashion that was available on the earth of their time. For example, while dinosaurs ruled the land some other reptiles took to the sea and others even invaded the air spaces to become the well known Pteradactyls.

The greatest part of the Age of Reptiles had already passed before the Edmonton formation was deposited in Alberta. Most people think of dinosaurs as huge four-legged creatures with long necks and tails and tiny heads, but in fact this kind of dinosaur called sauropods had largely disappeared before any of the Canadian dinosaur beds were deposited. True sauropods still lived in the southern hemisphere and even in the southern parts of the United States (albeit in small numbers), but no remains of sauropods have ever been found in Canada, nor are they likely to be found here.

Many different kinds of dinosaurs however, did exist in the region now traversed by the Red Deer river. Those from the Drumheller district can be grouped roughly into the carnivorous and herbivorous kinds. As usual in nature there were fewer carnivorous than herbivorous ones and these consisted of huge bipedal beasts 35 feet in length and of small animals perhaps no larger than a good sized dog. Of the smaller varieties we know very little because their fossil remains are rare and when found consist usually of teeth and isolated broken bones. The larger carnivorous dinosaurs were exemplified by *Albertosaurus* which was an ancestor of the world famous *Tyrannosaurus rex*.

Albertosaurus had a short neck and body, a long tail, huge head with a mouth full of sabre-like teeth four inches long and powerful hind legs with feet which resembled those of a turkey. The front legs were by contrast so small as to appear practically without function.

Constructed along similar lines but more slender of body and only about nine feet in length were the ostrich mimic dinosaur called *Struthiomimus*. Its bone structure tells us that *Struthiomimus* was a true carnivorous dinosaur by descent but it had become adapted to another mode of life. Instead of the powerful jaws armed with fearsome teeth its feeding mechanism was weak and teeth had been replaced with a horny bird-like beak. Its neck was relatively long and slender. Its hindlegs were long and slender. The front legs were longer in proportion than they were in its larger carnivorous colleagues. The food of *Struthiomimus* is somewhat of a mystery. Perhaps it consisted of fruits, berries, insects, eggs, either one or all. One thing is certain, it was a very agile and swift moving animal which resembled an ostrich without feathers.

The plant eating dinosaurs can be divided into several groups including the duck-billed, horned, armoured and others.

The duck-billed dinosaurs were by far the most common animal of their day in the Drumheller district. One species called *Edmontosaurus* was nearly 30 feet long. It had a long tail, which was flattened from side to side, heavy hind limbs, short front legs and a moderately long and slender neck. Its head was not unusually small as dinosaurs heads go and the jaws contained batteries of specialized teeth. There were perhaps a thousand or more teeth present in the mouth of a single animal, although only around two hundred of these were in use at any one time during its life. The other teeth were held

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in reserve and came into use as the ones above them were worn off. As the name implies, the duck-billed dinosaurs have a peculiar toothless snout which when viewed from different angles reminds one of the bill of a duck. These animals were presumably sluggish beasts which spent most of their time in pools of the great Edmonton delta, both in order to escape the fearsome *Albertosaurus* and also literally to take the weight off their feet. These animals weighed several tons and the bones were constructed so that probably they could not support the weight of the body on dry land for very long at a time. Usually, skeletons of the duck-billed dinosaurs are found lying on their sides with the head thrown back, the forelimbs dangling in front of the body, the tail extended out in a more or less straight fashion behind and the legs strongly flexed suggesting a swimming position. In many cases we have found impressions of the skin preserved in the rocks around their bones so we know that the hide of the duck-billed dinosaur was composed of scales which were arranged in various ornamental way. We do not of course know anything about the colour of the 'skin' or of the colouration of any other dinosaur for that matter.

Edmontosaurus was not the only duck-billed dinosaur of this region. There were other, both larger and smaller, which had strangely developed heads. Whereas the bodies of the duck-billed dinosaurs were pretty much alike, the tops of the heads of the different species differ greatly from one another. For example, the head of *Edmontosaurus* was flat on top but some of its close relatives had greatly swollen foreheads and one had a long spike that projected backwards above the neck.

Typical of the horned dinosaurs were the swamp-dwelling creatures called **Anchiceratops**. This animal was not quite as large as an elephant but probably weighed a couple of tons. It walked on four massive legs of which, (as in all dinosaurs) the hind ones were much longer than those in front. The tail was short for a dinosaur and was possibly carried off the ground. There was practically no neck, in fact some of the bones in the neck had solidified into a single mass in order to strengthen the support for the gigantic head. *Anchiceratops* and the other horned dinosaurs were unusual among dinosaurs in having heads of tremendous size. In *Anchiceratops* the head accounted for almost a quarter of the length of the animals' body. It consisted of a sharp hooked beak that resembled that of a turtle, a fairly long face and behind, a broad sheet of bone formed an ornamental shelf of frill that projected over the shoulder region. There was a small horn on top of the beak above the nose and a larger one over each eye. The teeth resembled those of the duck-bill dinosaurs, but were less numerous. The jaws were extremely powerful.

Whereas the duck-billed dinosaurs were evidently defenceless away from the water, the horned dinosaurs presumably could give a good account of themselves in any encounter with *Albertosaurus* or his unfriendly relatives. For, not only did the bony frill behind the head protect the front part of the body from frontal attack, the horns bore at the unprotected belly of the great flesh-eaters, which it will be recalled walked on their hind legs with the front part of the body well elevated.

There were many different kinds of 'horned' dinosaurs (some of which it may be noted did not have horns) but not many are found in the Drumheller area. A very small species has been found upstream from the town of Trochu and the ancestors of the famous **Triceratops** is known to occur in the Edmonton rocks near Morrin ferry.

The other great group of dinosaurs were the armoured forms. Imagine a modern day "horned toad" 20 feet long and five or six feet wide and you will have a fair idea of what these pre-historic tanks must have looked like in life. Their bodies were low and broad and supported by pillar-like legs, which instead of long slender toes and claws had feet that probably resembled large land tortoises of today with stubby hook-like ends of the toes. The upper side of the body was covered with a mosaic of horny plates and along the sides were curved spikes which became very large and heavy in the region of the shoulders. The heads of armoured dinosaurs were small and com-

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pletely covered with thick bony plates above and on the sides. The tail was long and so stiffened by bony rods along the sides of the vertebrae that it was evidently rigid at least in its back portion. At the end of the tail were large almond shaped chunks of bone which fitted together to form a club-like structure. This tail in life must have resembled a gigantic mace. One can imagine that such a creature was partly immune to attacks by Albertosaurus; when danger threatened it may simply have squatted down and swept its tail back and forth in a broad arc behind it. Conceivably the tail club could have cut the feet of a carnivorous dinosaur completely out from under him. In this connection it is interesting to note that many shin bones of carnivorous dinosaurs show the results of severe injuries during life.

Many armoured dinosaurs had their teeth greatly reduced in size and numbers and evidently depended on a horny beak and tough cheek pads to obtain their food which consisted probably of low, soft leafy plants.

All of these dinosaurs lived in or close to bodies of water. They were lowlanders. On higher ground there existed other dinosaurs about which we know very little because their carcasses seldom were buried where they could become fossils. One that is worthy of mention is the bony headed dinosaur, **Stegoceras**. The roof of the skull was composed of a great sphere of solid bone, the function of which is still a mystery to paleontologists. The skull bones are fairly common fossils because they were so solid they have resisted disintegration better than the rest of the skeleton which was a fairly delicate affair. The **Stegoceras** was not a large dinosaur, possibly a length of no more than three feet.

So much for the common dinosaurs of the Drumheller valley. There were others but we know very little about them. They were relatively insignificant in number. Many and varied ancestors of these Drumheller dinosaurs are found as fossils elsewhere in Canada. The famous **Triceratops** and **Tyrannosaurus** which are descended from dinosaurs from the Drumheller area are known to occur further upstream on the Red Deer river. These animals were among the very last of the dinosaurs and as yet no very complete specimen of either has been discovered in Alberta.

HOW ARE DINOSAUR SPECIMEN COLLECTED?

It is a popular misconception that the fossil hunter finds his bones by digging for them. Nothing could be more futile. The proverbial needle in the haystack would be much easier to discover than a dinosaur in the Drumheller valley if this were the method employed by paleontologists. Fortunately the fossil hunter has the assistance of Mother Nature and the processes of erosion expose the fossil bones to view in just the same way as it exposes the rocks which surrounds the fossils. When the paleontologist enters an area of erosion his eyes are glued to the ground, while he prospects for fragments of broken fossil bone that have been brought to the surface through the vari-

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ous processes of erosion. Usually, when such fragments are discovered careful investigation will lead only to the discovery of a piece of a bone; a vertebra or two, possibly a leg, a foot, a skull, but only occasionally does such a prospect lead to the discovery of a complete skeleton. It may require many days, weeks or even months of tedious prospecting to discover a complete dinosaur skeleton such as those to be seen on display in many large museums all over the world.

At some places there occur accumulations of bones of dinosaurs and other animals piled helter skelter in a fairly restricted area. These deposits are known as bone beds and may not contain material that is suitable for museum displays. A well exposed bone bed of this type occurs east of Morrin ferry. There are others on the west side of the Red Deer river north of Munson ferry. These bone beds apparently resulted from the washing about of decaying dinosaur carcasses on the shores of ancient bodies of water and they indicate that for some reason a large number of animals died at approximately the same time.

Once a favourable prospect has been discovered a great deal of work in the form of physical labour is required to remove the specimen from its burial place to the museum. This may require excavation with shovels and picks. Sometimes even dynamite judiciously employed is brought into play. It may be necessary to remove tons of rock from above the skeleton in order that the paleontologist may uncover the bones and once the excavation has progressed to the point where the bones are almost exposed then the heavy tools are discarded in favour of such implements as small awls, hammers and chisels, whisk brooms and paint brushes and the like. The bones of the skeleton are outlined with these more delicate implements and as each new area of bone is exposed to the air it must be treated immediately with solutions such as shellac which will harden the bone and protect it against the drying effects of the atmosphere. This may sound strange if the bones are actually petrified or turned to stone, but as a matter of fact freshly exposed fossil bones are often most brittle and soft and the drying effects of the air produces very unfavourable results in many cases. Of course the bones cannot be completely freed from the rock in the field. This is a time consuming operation that can only be accomplished in the museum laboratory.

As soon as the bones have been fairly well exposed on the upper side, trenches a foot or so wide are dug all around the bones so that in effect the bones are left resting on a pedestal of the original rock. Then the bone exposed in the upper side of the pedestal is covered with wet tissue paper, and on top of the wet tissue paper are laid bandages made of strips of burlap dipped in plaster of paris and wrapped or in much the same fashion as a doctor would place a plaster cast on a broken arm. If the bones are large it may be necessary to emulate the doctor more closely by employing splints which are usually made of any sort of wood that can be obtained in the vicinity of excavation. As soon as the plaster jacket on the upper side of the pedestal has hardened the rock is cut away from the under side and the plaster jacket containing the bones and upper part of the pedestal is turned over and the same procedure is repeated on the under side. The result of this work is a fossil bone completely encased in a plaster of paris cast which, if it is properly made, should protect the bone during its transportation from the field to the museum and the bone should arrive at the museum in the same state of preservation in which it was removed from the ground. Once the fossil has been received in the museum laboratory the upper half of the protective plaster is cut away and the bone is again hardened and strengthened by the application of various solutions. The rock that still remains adherent to the bone is carefully chipped, scraped or ground off. The broken pieces of bone are removed and cleaned and then are fastened back together with various types of glue and plaster. In the case of long bones sometimes it is desirable to drill holes through the centres and insert iron rods, wires or some other means of strengthening the fossils internally and then they are put together with plaster. This procedure is referred to as preparation. After the fossil bones have

(Continued On Following Page)

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been prepared they are then studied, identified and classified by the paleontologist. If they are of scientific interest the paleontologist usually prepares a highly technical report which is published in some professional journal and announces to the scientific world the discovery of a new creature or some interesting fact about an extinct animal that had not been previously known to science.

If the specimen is exceptionally good it may then be placed on display in a museum where the public as well as the scientist can take advantage of it and this is the way in which the magnificent dinosaur skeletons in many of the world's large museums have come to reside in exhibition halls. In mounting a dinosaur skeleton a tremendous amount of work is involved from a purely engineering point of view. Because the bones are extremely heavy and at the same time are exceedingly fragile it is necessary to support them on iron work or scaffolding which must be fashioned very carefully so as to fit the irregular configuration of the dinosaur bones and at the same time detract as little as possible from the skeleton itself. Mounting a large dinosaur skeleton in this fashion may require the complete efforts of one or two men for periods of two, three or even more years. If, as is usually the case the specimen is not completely represented, since part of the animals skeleton may have been carried away before the carcass was buried and part of it may have been destroyed by erosion before the skeleton was discovered by the paleontologist some missing parts of the skeleton may have to be reconstructed in plaster of paris. This is a quite legitimate solution to the problem because otherwise, even though the scientist may have a good idea of what the complete structure of the animal looked like, the laymen may not be able to understand the structure of the animal if, for example, the skeleton was mounted with only three legs and only the back half of the tail with nothing in between it and the rest of the body. So these missing parts are frequently reproduced in plaster using either bones from the opposite side of the same skeleton as a guide, or else using bones from skeletons of other individuals of the same or very closely related species. In this way the public is assured of the accuracy of the reconstruction, and need not fall prey to the sometimes heard exclamation in museums, "After all they make these things out of plaster." This is not the case!

WHAT KILLED THE DINOSAURS?

It is impossible to state definitely what caused the extermination of the dinosaurs. It is also impossible to state whether a single factor was operative or a combination of many.

Perhaps the most general explanation would be that these great animals were unable to adapt themselves to changing conditions. They may have succumbed to other more progressive animals. They were cold blooded, sluggish, with a small and lowly organized brain in comparison to their bulk, which may have made it difficult for them to compete with more efficient warm blooded mammals which appeared at the end of the Cretaceous period. Small mammals could also have preyed upon their eggs.

There may have been other changing conditions in their environment such as a sudden climatic change, perhaps a flood, perhaps a suffocating blizzard of volcanic ash and gas. A change in food supply may have been an important factor and food supply change may have been brought about to some extent by alteration in climate which also could have affected the dinosaurs, but probably affected the type of vegetation. Perhaps the draining of the lowlands was another factor. The great problem in explaining the extinction of any group of animals lays in the fact that an explanation that would account for the extinction of any one animal or one small association of animals may not be sufficient to account for the extinction of the really great variety of features which actually occurred. There is no really good explanation of extinction that would account for the disappearance of the dinosaurs on land, the flying reptiles in the air and the marine reptiles in the water.

It is believed that a race or order can become old and weak in the same way as an individual. This is called racial senescence. This is often accompanied by (Continued On Following Page)

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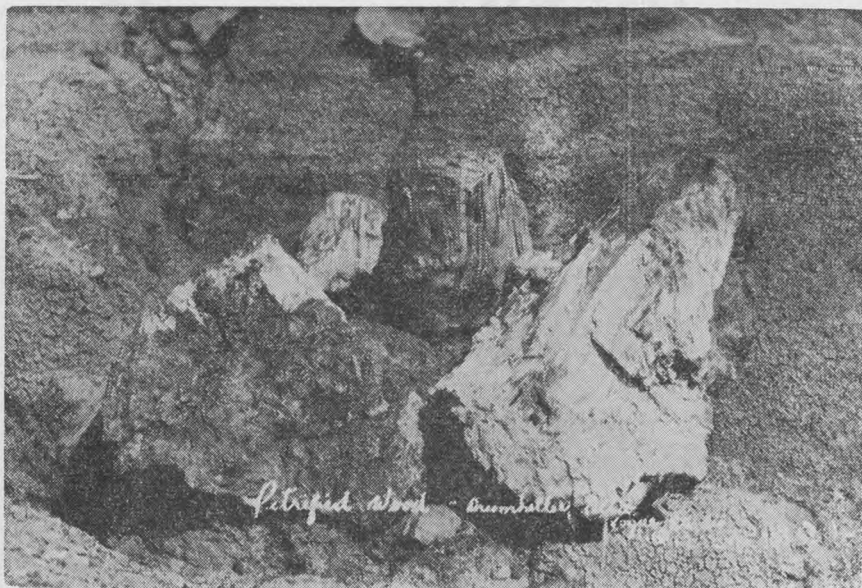
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ied by overspecialization. During the closing years of the Cretaceous period the number of species and individuals gradually became fewer, although more highly specialized and gigantic. Large, specialized forms are easily exterminated if subjected to a change in habitat or food supply.

It should be born in mind that these extinctions did not occur instantaneously or overnight, so to speak. They were long drawn out affairs which took probably millions of years to accomplish, that is speaking of the reptiles as a whole. Of course it was quite likely that local extinctions may have done away with all the dinosaurs in a specifically restricted area in a brief period of time.

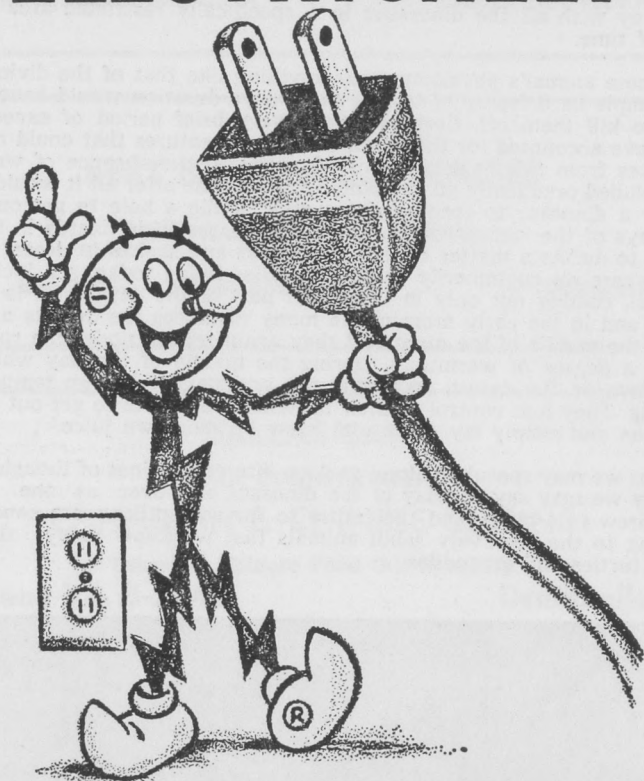
If these animal's physiology was anything like that of the diving reptiles, just a simple hard freeze of two or three days duration would have been sufficient to kill them off. Certainly, too, a very brief period of exceeding heat would have accounted for the death of all the creatures that could not protect themselves from this heat, and this of course in the absence of water would have included practically all the dinosaurs, because after all it would be pretty hard for a dinosaur to crawl under a rock or dig a hole to get out of the direct rays of the sun, as modern reptiles and the little lizards in the deserts are able to do. As a matter of fact the lizards and snakes in desert areas, and this is where we customarily think of reptiles living today, are inclined to be nocturnal, coming out only in the cooler part of the day which is in early evening and in the early morning. In many instances the deserts are cold for them in the middle of the night and they again retreat under the rocks, where there is a degree of warmth. During the middle of the day when the sun beats down on the desert, no reptile can withstand this high temperature for very long. They lose control of their muscles, are unable to get out of the rays of the sun and simply lay down and 'stew in their own juice.'

Thus we may speculate along various interesting lines of thought. But with certainty we may say the day of the dinosaur was over as the Cretaceous period drew to a close, and the future so far as reptiles were concerned was to belong to the relatively small animals that we know today, the lizards, snakes, turtles and crocodiles.



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By MARIAN SMITH

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Drive straight west of Drumheller for one and a half miles where you will see on your right a sign directing and welcoming you to Newcastle Beach.

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The Oopland Express was formerly a hard working Diesel unit hauling coal through miles of underground tunnels in a mine. When the mines closed, it was destined for the scrap heap along with hundreds of others of their kind. Battered and begrimed, the ten little cars were purchased, along with the locomotive, by a group of Newcastle residents who had little money, but a lot of enthusiasm and willing hands. Repaired, fitted with seats painted in gay colors; a mile or so of narrow gauge railroad was built near the beach for them to run on, as well as a tiny station where the biggest little railroad begins and ends at the centre of the beach.

Newcastle beach is not a commercial venture. It is, however, a fine example of what one small, but enterprising community did with their portion of the recreational funds donated a few years ago to all Alberta communities.

APPRECIATION

I wish to thank the advertisers, The Alberta Travel Bureau and The City of Drumheller for their support in making the 1964 issue another success.

The circulation is now greatly improved. The Alberta Travel Bureau, besides meeting its local requirements, supply their Tourist Bureau in Las Angeles and Canadian Government Tourist Bureaus in San Francisco, Chicago and New York. The Alberta Tourist Association has charge of the Alberta circulation and showing wonderful results. The Drumheller and District Museum Society use many books as they come in contact with Tourists from many countries. The advertisers meet many tourists and appreciate having books available to give those seeking information.

The advertisers are giving their support for the benefit of the tourist. Support them.

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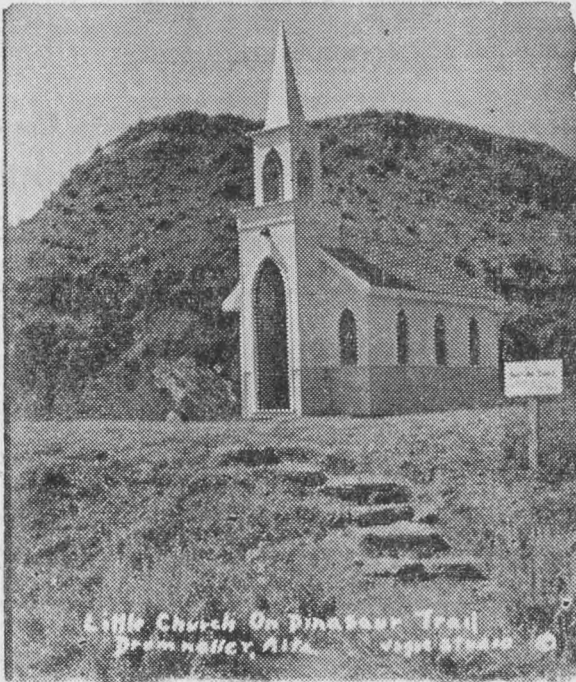
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OUR LITTLE CHURCH

By BILL DOWSON



All of us, no matter what our religious beliefs or church affiliation, find that expressing ourselves to God is sometimes a difficult task. We pray in our churches or in the out of doors. We teach Sunday School or pick flowers from the garden for the church pulpit. We sing in the church choir or we spend a little time each day reflecting on the things the Lord created for us on our planet. Or we make a child smile or visit a sick friend. In these ways and the many others in which we express our gratitude to God, we are in actuality thanking him for the gift of life and the living of it.

The little church in our valley was built by men who, through their own skill and imagination, were expressing their thanks to God.

The sign painter laid aside his coarse brushes and tracing paper to take in his hand the soft brush and the oil paints with which he transferred stories from the Bible to the glass of the church's windows.

The construction man laid down the blueprint and the level, and took into his hands, which have been toughened by years of working with concrete and steel; the hammer; and with his knowing touch helped to build the church. The men that helped him, drove the nails with a skill they could not have acquired in their jobs for they were clerks, shop-keepers and men of business.

The minister that helped in the building laid aside his coat and Bible to carry shingles and lumber, for he is a builder too.

And when the bell was hung in the steeple and the little church gleamed brightly finished in the sun, these men, each of them, knew that he had not just helped build a church, but had assisted in erecting a tribute to the Almighty.

Not one man said this to another, but each one knew. For we all express ourselves in different ways to God and men don't discuss these things aloud.

So our little church, which seats 100,000 six at a time, is more than a pretty landmark, more than a tourist attraction. It is an expression of thankfulness for that is the kind of men these are.

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WAYNE — THE BADLANDS OF THE ROSEBUD CREEK VALLEY

By T. H. HANSON

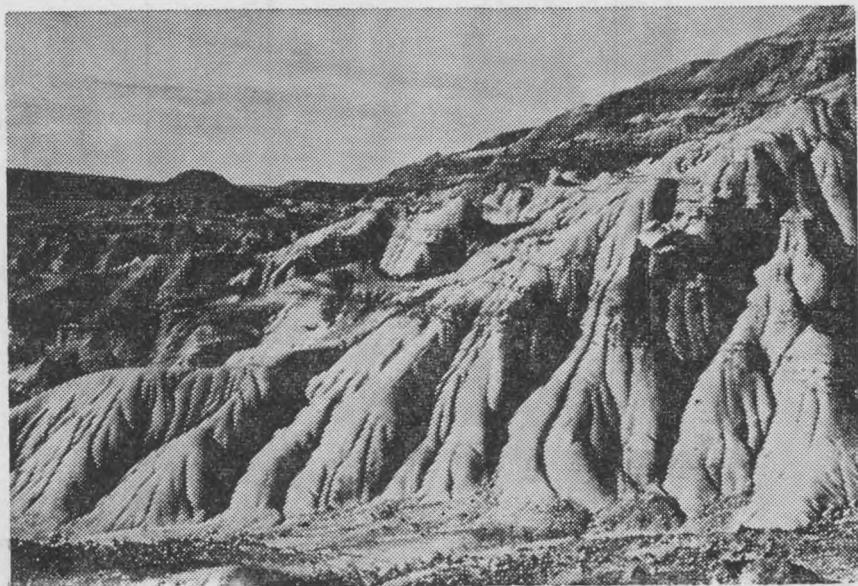
A side trip for lovers of fossil-hunting is the Wayne section of the Badlands. Turning south by car from Rosebud, one winds between 450 feet high hills which seem much higher because the Rosebud Creek Valley is so narrow. The road crosses and recrosses the creek many times indicating a rather high cost of building eleven bridges in the distance of three miles.

The first sight of Wayne makes it rather hard to imagine a thriving town of forty years ago supporting a large population and four large coal mines. Little is left as evidence of the prosperity it once experienced.

However, evidence of an even mightier age remain and from here the trip is on foot. The Wayne valley is criss-crossed by deep coulees which are a fossil-hunters delight—if he wishes to work for his prize. Much climbing and walking are necessary for a successful trip. The Home Coulee, which enters the valley at the centre of the town seems to be the best place to pick up a wide variety of fossilized marine life. These are washed to the floor by spring-like run-off and include samples of mollusks, echinoids and corals.

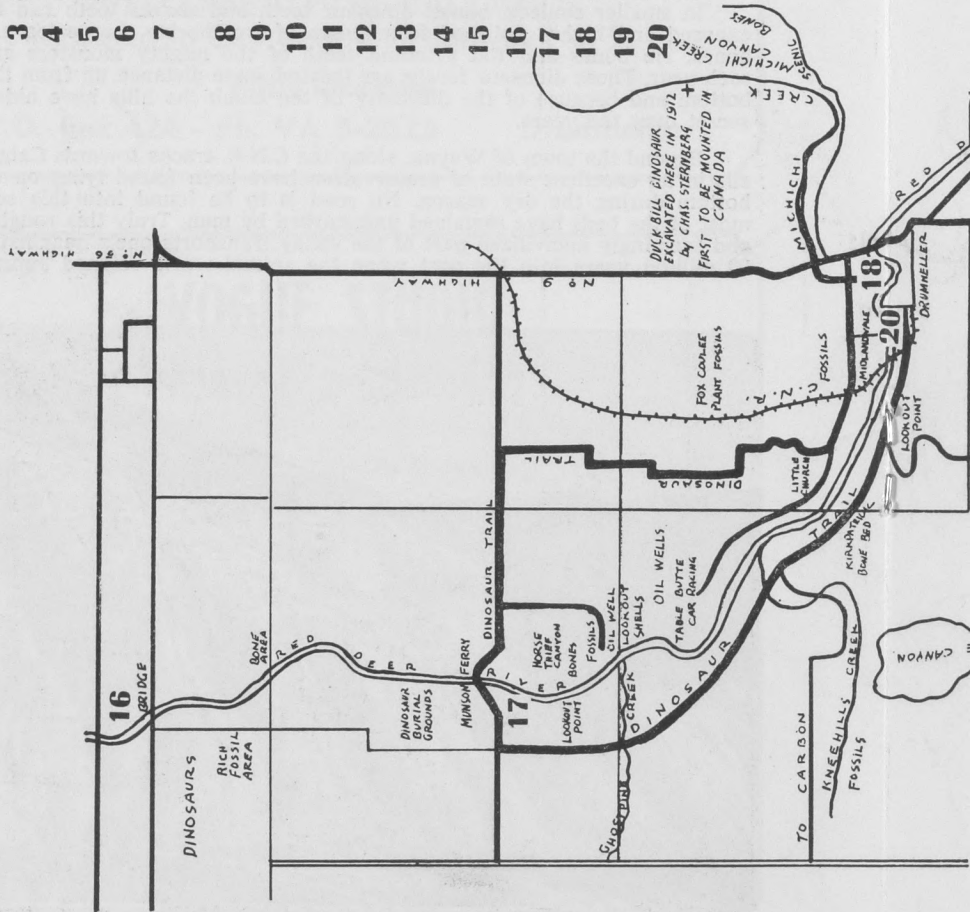
In smaller coulees, bones, dinosaur teeth and sharks teeth can be found exposed and highly polished from years of weathering. Large leg and thigh bones, rib bones and flat grinding teeth of the mighty monsters are found each year. These dinosaur fossils are located some distance up from the valley bottom and because of the difficulty of the climb the hills have hidden their secret over the years.

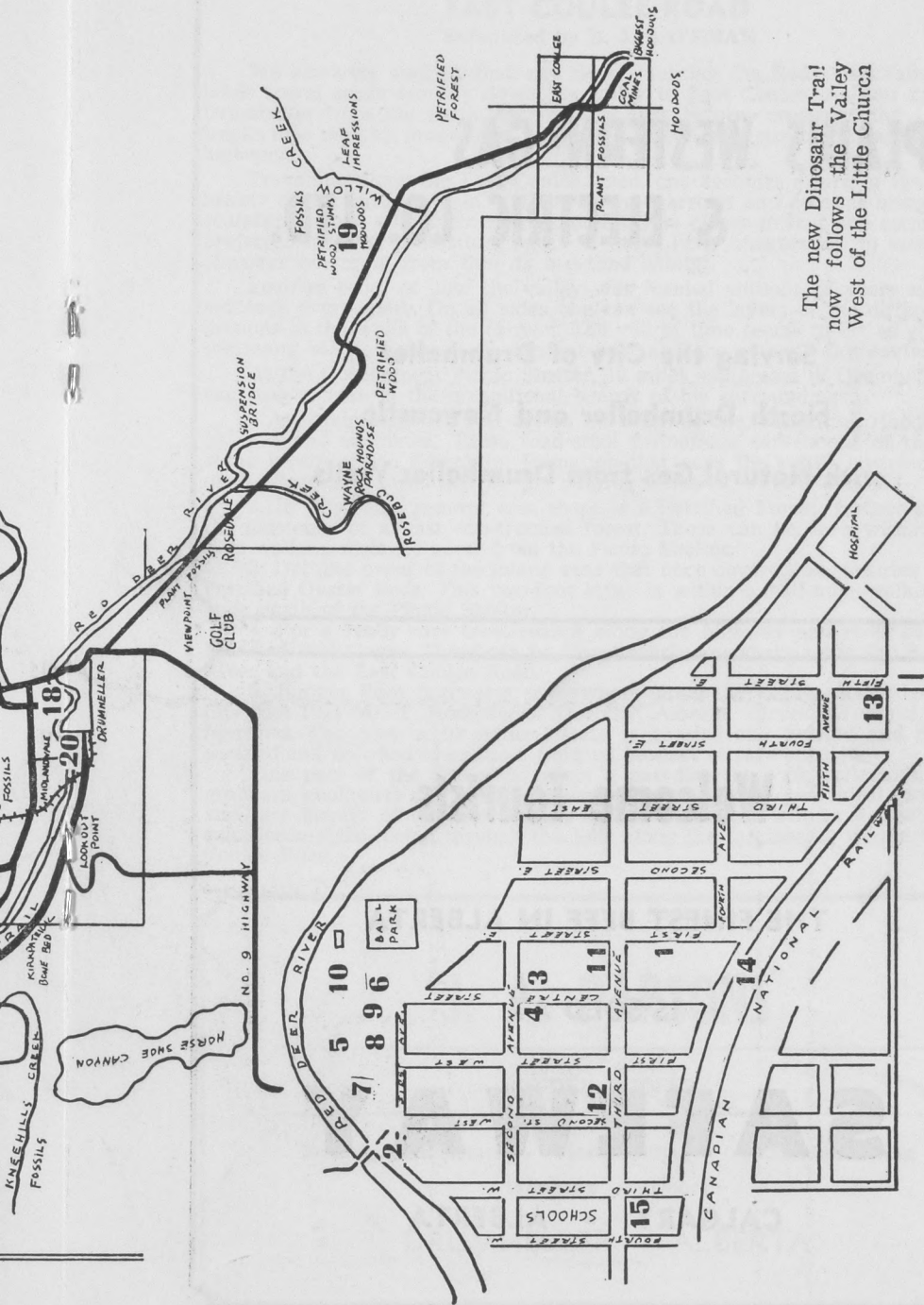
Beyond the town of Wayne, along the C.N.R. tracks towards Calgary, fossils in an excellent state of preservation have been found lying on the river bottom during the dry season. No road is to be found into this section so most of the beds have remained undisturbed by man. Truly this rough, rugged and seemingly uncivilized part of the valley transports one's imagination back 90 million years into the past when the animal world reigned supreme.



A VIEW OF THE BADLANDS

- 1 DRUMHELLER & DISTRICT MUSEUM
- 2 TYRANNOSAURUS REX
- 3 CITY HALL
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A GLIMPSE INTO THE PAST ALONG THE EAST COULEE ROAD

Submitted by R. J. BATEMAN

We sincerely suggest that any person touring the Red Deer Valley Badlands travel south-easterly down the valley to East Coulee. As you approach Drumheller from the south, take a right turn before crossing the railway tracks into the city proper and follow the fifteen-mile stretch of hard-surfaced highway.

Travelling along the East Coulee Road, one becomes aware of the unique beauty of the entire terrain. The valley narrows and deepens bringing the sculptured walls with their multi-colored layers closer so that one seems to be projected into the prehistoric past. It takes little imagination to visualize a dinosaur emerging from this its one-time habitat.

Positive proof of how the valley was formed millions of years ago is in evidence everywhere. On all sides one can see the layers of the different formations in the walls of the canyon. The veil of time seems to lift as you view the many stages between the distant past and the present day environment.

At the Government Picnic Shelter, 12 miles south-east of Drumheller, one can stop to take in the magnificent beauty of his surroundings.

1 Approximately 500 feet across the highway the fascinating Hoodoos can be seen and examined. These toad-stool formations carved out of the sandstone layers of the Edmonton formation that caps the softer layers of shale of the Bears paw formation by the natural action of wind and rain.

2. In this same general area there is a Petrified Forest, further proof of the existence of a vast sub-tropical forest. These can be seen within a half mile walking distance north from the Picnic Shelter.

3. Definite proof of the inland seas that once covered our prairies are the Petrified Oyster Beds. This two-foot layer is within a half-mile walking distance north of the Picnic Shelter.

4. For a really rare treat search along the highway and river banks for Petrified Pine Cones. These can be found nearly anywhere along the Red Deer River and the East Coulee Road.

5. Juniper Root is present everywhere along the valley rock ledges. It is this root that Mr. T. Hodgson of Dorothy, Alberta, carves his world famous figurines. The root in its natural state is gnarled and twisted and must be scraped and polished to create a finished product of rare beauty.

This part of the Badlands offers a paradise for rock collectors, photographers, geologists and tourists interested in the unique geological formations and rare beauty of this picturesque valley. Travellers will have a wonderful experience sight-seeing through the hills along the fascinating wonderful East Coulee Road.

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DRUMHELLER, ALBERTA

CHAMBER OF COMMERCE WELCOMES YOU

On behalf of the members of the Drumheller and District Chamber of Commerce I wish to welcome you, the tourist to the Drumheller Valley. To the tourist who is visiting Drumheller for the first time, I can assure you that you have a real treat in store for you. To the tourist who is returning to Drumheller welcome once more. May your stay in Drumheller be just as pleasant as your previous one.

The Drumheller and District Chamber of Commerce are this year celebrating their forty-sixth year of service to this community. Many changes have taken place in the Drumheller Valley during those 46 years, and Drumheller today has developed into a modern city with the conveniences of a much larger centre.

Take a leisurely stroll through Drumheller's main business district. Notice the new and modern look on many of Drumheller's stores. Notice the fine window displays, the modern styles—notice also the variety of services available in Drumheller. Browse through the various stores throughout the city. The ladies will find that the stores here carry a complete line of ladies wear in the very latest fashions. Men will find the clothes of their choice in any of the many men's wear stores. Drumheller grocery stores and super-markets compare with the big city stores and prices are as low as in any of the stores in Alberta.

Drumheller has many fine restaurants and coffee shops conveniently located throughout the city. These restaurants serve a variety of good wholesome meals in clean and modern surroundings.

Drumheller is noted for its fine churches and there is a church of almost every denomination in the Drumheller area. Be sure to attend church at least once while in Drumheller, you will be glad you did.

There is recreation and sport of every description in the Drumheller area. During the winter months you can attend some of the best hockey in Alberta at the Drumheller Memorial Arena. For the curler Drumheller has a fine new curling rink. You can skate in the arena or toboggan on the hills surrounding the city. A new bowling alley will be opening this summer for the bowling enthusiast.

In the summertime, you can take a refreshing swim in the Drumheller Rotary Club Swimming Pool or for the youngster who is just learning to swim there is the wading pool or the learner's pool now in operation. Baseball and fastball are played frequently in the John Anderson Memorial Park or the fastball diamonds in the city. For the golfer a nine-hole golf course on the southern limits of the city is a challenge to any golfer and from here you will get an unexcelled view of the Dinosaur Valley. This is your last opportunity to play on this course—progress of the City has forced the closing of this course at the end of this year and a new beautiful course is being built near the Little Church.

For variety take a trip out to the Newcastle Beach on the Western outskirts of the City. Here you can sun bathe on the hot sandy beach of the Red Deer River or take a dip in the tepid water of this river.

For a change of pace, pack a lunch and climb the hills surrounding Drumheller. Here you will find interesting prehistoric specimen, petrified wood, etc.—Go ahead, take a souvenir, but please leave some for the tourist that will follow you. Take a trip on Dinosaur Trail, see the oyster beds, the oil wells, visit the Little Church. East of Drumheller see the dolomites and walk the swinging bridge. All these sites are within a few miles of Drumheller and offer the photographer some of the finest pictures he has ever taken.

The fisherman is not forgotten. Fish along the bank of the Red Deer River or visit the stocked dams. Ask at the service station or restaurant, the courteous staff will direct you.

For accommodation Drumheller offers fine motels and excellent hotels and for the camper there are convenient campsites both in the City and on the outskirts. There are many Alberta Government picnic sites in the area. It all adds up to a new exciting holiday with the convenience of modern and clean stores with a variety of reasonably priced articles.

Once again I wish to welcome you to Drumheller — may your stay be a pleasant one and return again whether it is for just a night, a week-end or a full holiday.

—MICHAEL DANYLUK, President.

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HOODOOS



"HOODOOS", DRUMHELLER, ALTA.

The rock layers exposed in the Red Deer Valley walls are composed of different materials such as sandstone, shale, clay ironstone and coal. Since these rocks differ greatly in hardness some of them resist erosion better than others. The harder rocks are usually thinner than the softer ones in this particular region. When the hard layers are undermined by the erosional activity of wind, running water, freezing, thawing and so on, the harder layers tend to remain as protection for the softer rocks below. As erosion progresses however, the softer rocks and then the protective harder tops become separated from the adjacent rock masses and this often results in a sort of gigantic "toad-stool" structures that have been termed Hoodoos. Hoodoos are a characteristic feature of badlands everywhere and may vary in size from tiny structures a fraction of an inch in height to massive pillars as tall as buildings. Some good examples of Hoodoos can be seen at Willow Creek where resistant sandstone layers at the base of the Edmonton formation cap pillars of softer and more easily eroded shale of the Bearpaw formation.

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FOR MEN ONLY (?)

By BILL DOWSON



Perhaps while you're reading this Dad, you're lying under a blue sky, surrounded by green grass and the warm summer wind of the valley is whispering through the thick foliage of our famous cottonwoods along the river.

Just for a moment, imagine that the sky is grey and overcast with a ceiling of about 800 feet. Imagine huge grey and black cloudbanks driving south ahead of a chill November wind, which rustles the dry brown grass, and ripples the surface of the slough in front of you. You crouch down lower into the collar of your heavy canvas coat, tug at your cap to get the ear-flaps a little lower and you shift the cold blue barrel of your shotgun along the crumbling earth edge of the pit in which you sit. Then, out of the corner of your eye, you catch the hand signal of the man on your right—you cock an ear to the sky, lift an ear-flap, hold your breath and listen. And high above, on the very edge of the storm, louder than the wind in the rushes, you hear the scalp-tingling honking of a flight of Canada Geese. Now you're crouching on your haunches, shotgun ready. Your dog has heard the fabulous birds and sits quivering in the pit, ears erect, tail pounding on the hard frozen earth. Then the khaki-clad arm of the shootmaster pokes itself out of the rushes and you hear him yell SHOOT!

This scene is re-enacted every year in the Drumheller district during the Game Bird season and is very familiar to fellows in this part of Alberta.

But suppose you make your home in Eastern Canada, or in a portion of the United States that doesn't offer goose hunting opportunities like this? Dad, have you ever thought about coming back here in the Fall to get in on a goose shoot with the boys? We'd love to have you, and there are plenty of fellows in the area who would be tickled to take you out with them after a bag of birds. This area offers some pretty wonderful birds too—Pheasant, Canada Goose, Prairie Chicken, Partridge, Hungarians and of course ducks of all kinds from Mallards to Butterballs.

Our game warden, whose office is located in the Provincial Building, just across the street from our City Hall, can fill you in on all the details, and give you license prices, regulations and bag limits and directions. The same fellow would be pleased to give you any information you might need if you'd care to hunt through the Valley for Mule or White Tail Deer or Antelope.

Like I say, we'd love to have you back Dad, if you care a whole lot for hunting. We'll even find somebody to pluck and freeze your birds for you, and Drumheller is within easy driving distance of the finest Game Bird flyways in North America, which streak over towns like Consort, Coronation, Cereal and many more.

Today, when you have a minute, slip downtown and have a chat with our Fish and Wildlife man. Then when you get back home, get a bunch of the boys together, split costs and head back to the Big Country where the birds are the greatest. I can guarantee you Dad, you've never in your life experienced anything like a Big Country goose shoot. Or a day on the prairie pheasant hunting. Unless, of course, you've been here before.

Hotel accommodations are more economical in the Fall too, and your hosts will take care of you like a king.

Dad, if you find it economically impossible to get in on a goose shoot at James Bay, or if you're from a part of the U.S. that's getting just a little crowded with folks who don't tolerate bird hunting, come on back and see us this Fall.

Join the hundreds of fellows from Eastern Canada and the United States that head for The Big Country every fall to hunt our wonderful birds. I know Dad, it'll be an experience you'll never forget.

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DRUMHELLER CHAMBER OF COMMERCE ACTIVITIES 1964

As in the case with all projects of Chambers of Commerce, finances govern the extent of their activities—as this is being written many plans for 1964 are hanging fire which will be initiated as soon as we are assured of adequate funds. The City of Drumheller is currently considering our request for assistance in the field of Tourist Service and Promotion. The Chamber feels the request will be met as the tourist business has become a very important factor in the economy of the Dinosaur Valley.

The tourist will find both the City area and the Dinosaur Trail area, better marked than it has been in the past. The Tourist Committee decided in the Fall of 1963 that lack of identification was one of our greatest weaknesses and over the winter has spent much time and money in an attempt to rectify this. Also, following a request presented to the Provincial Cabinet Members whose departments are involved. The Dinosaur Trail Route has been changed and improved so that is now more completely scenic than it was, and slightly shorter. The area cut out was a section of farm land which was outside the Valley.

Through closer liason with the City and with the local staff of the Dept. of Highways, we are endeavoring to have our Campsite facilities kept to a higher standard than in past years. Vandalism has been one of the greatest headaches in making sure these facilities were maintained. The city's Campsite behind the Memorial Arena and on the bank of the Red Deer River, has been enlarged considerably. On occasions when standards are not met the Tourist Committee will appreciate all the help it can get from tourists in correcting the conditions. Contact any member of the Chamber of Commerce.

The Drumheller and District Museum Society has had a crew busy all winter improving the facilities and exhibits. We of the Tourist Committee are happy to have such an aggressive and interested group allied with us in attempting to make the Dinosaur Valley area more attractive to travellers. The Alberta Tourist Association will again provide information from the Museum as was done last year. In addition, when requested in time, guides can be provided for individuals or groups touring the Valley.

Finally, again depending on the limitations imposed by finance, the Tourist Committee plans to distribute around 25,000 pieces of promotional material throughout Western Canada, designed to inform travellers of the unusual and attractive area which we call "The Valley of the Dinosaurs."

—DON F. ANDERSON,
Chairman,
Tourist Committee.

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DUCK-BILLED DINOSAUR EDMONTOSAURUS

The bones of the *Edmontosaurus* skeleton in the Drumheller and District Museum were discovered and collected by Dr. C. M. Sternberg, formerly of the National Museum of Canada in 1923. They were found about six and one half miles West of Munson in the East bank of the Red Deer River, some 150 feet above water level in Sec. 15, T. 30, Rge. 21, West of the 4th Meridian.

The skeleton is about average size for *Edmontosaurus*, or possibly a little smaller than average. In life the animal weighed perhaps four or five tons. The fossil bones weighed about a ton. As mounted, the skeleton is 30 feet long and is about 8 feet high. When the animal stood on its hind feet the head may easily have extended 14 feet above the ground.

Edmontosaurus is the common dinosaur in the Drumheller Valley. Perhaps 90% of all fossil bones seen in the badlands belong to this and related duck-billed dinosaurs. These fossils have been preserved by processes of petrification for about 75 million years. The bones still retain their basic shape, but are often crushed and distorted by tremendous pressures experienced in the rocks during and following fossilization. The original bones were altered chemically and all hollow spaces have been filled in by foreign mineral matter, usually various combinations of calcite and iron, and in some cases even quartz.

When the animal died its carcass was soon buried in wet sand where decay eventually destroyed the soft parts leaving only the bones. While this was happening the soft sand settled in all around the bones causing them to remain in their natural position. Ground water gradually seeped into the bones and there began to leave some of the mineral matter which it carried in solution. The amount of this material increased until the physical characters of weight, hardness and colour had all been changed and the bones petrified. While this was happening additional sand and clay were deposited above the bones until a great thickness of sediments was built up and the sand and clays gradually changed into sandstone and shale. It was the weight of these sediments that crushed and distorted the bones. But it was also the great thickness of the rocks that preserved the bones for millions of years.

In fairly recent times the Red Deer River has eroded the Drumheller Valley and in the process has exposed the fossil remains of countless dinosaurs. Occasionally a good specimen is found and called to the attention of experts in time to preserve it, but there is no doubt that most fossils fall victim to the rapid erosion to which the soft rocks in the Drumheller Valley are subject.

Edmontosaurus was a fairly large duck-billed dinosaur. It lived in swampy environments on deltas along the edges of a great inland seaway which extended across North America during the age of Reptiles. Some of the rocks deposited upon these deltas are now exposed in the Drumheller Valley. Geologists call them the Edmonton formation. They represent a very brief span of time in earth history and record in their fossils only a glimpse of life toward the end of the Age of Reptiles. Thus *Edmontosaurus* is among the last — although by no means the last of the dinosaurs.

Edmontosaurus like its many duck-billed relatives was a harmless creature whose only defence against the great predatory dinosaurs of the day was an ability to swim. The skeletons are usually found in a pose that suggests swimming and it is known from tracks and certain unusually well-preserved skeletons that the feet were webbed. The stiff tail—strengthened by long bony tendons along the spines—was flattened from side-to-side and was doubtless used for a rudder in the water as well as a counter balance on land.

Impressions of the skin have been found in the rocks around some skeletons and these show that the hide was scaly as it is in reptiles generally.

We know nothing about the colour of the animals, but we suppose that the large defenceless duck-billed dinosaurs lacked bright markings that would attract the attention of enemies. They may have had skin patterns that helped

(Continued On Following Page)

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them blend into their surroundings and dark upper surfaces and lighter under surfaces that assisted them in controlling their body temperatures.

The duck-billed snout was covered by a long horny sheath and the fairly weak jaws contained hundreds of small teeth. These teeth were arranged in rows in such a way that when one tooth wore out it was immediately replaced with another. Such a method of replacement and the huge size of some of the duck-billed dinosaurs suggests that their life span was considerable, but no one has any idea of how long they lived. Some modern reptiles though, are known to live more than a hundred years, and it is suspected that some turtles have lived several hundred years.

Duck-billed dinosaurs were vegetarians and doubtless fed on soft plant material that must have been in copious supply in and around the swamps. The same materials provided the source for the coal of the Drumheller Valley. It is not unlikely that most feeding was done in the water, for not only did this environment provide protection from the non-swimming carnivorous dinosaurs, it buoyed up the heavy bodies and literally took the weight off the dinosaurs' feet. These feet and legs were none too well adapted to carrying great weight around on land; the joints were composed of relatively soft cartilage or gristle.

Duck-bill dinosaurs may have laid eggs, but if so, no shells have been found. This could be because the shells were leathery and thus subject to decay, or perhaps at egg-laying time, the dinosaurs left their swampy homes and migrated into drier and higher land. There the eggs would not likely become preserved as fossils because there is little chance of rapid and permanent burial where drainage is rapid. Remains of very young dinosaurs are very uncommon and even animals half the size of this skeleton are rare.

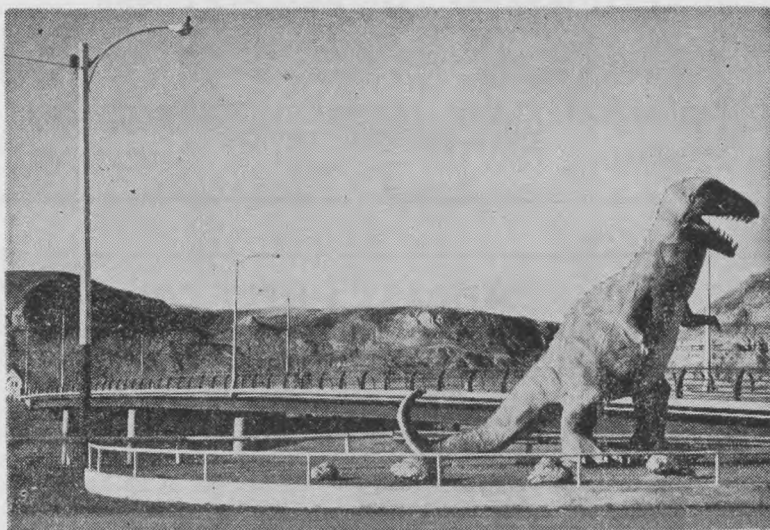
The bones used in this display were removed from the rock, cleaned, mended and mounted by Harold L. Shearman at the National Museum of Canada in Ottawa. The work required more than three years.

The skeleton was mounted in several sections which were shipped to Drumheller for assembly. The shipment weighed 8,000 pounds, boxed and crated. The project was supervised by Dr. Wann Langston, Jr., Curator of Vertebrate Palaeontology, National Museum of Canada.

Two questions frequently asked at the Museum are —

1. Why did so many dinosaurs die here?

(Continued On Following Page)



Tyrannosaurus Rex greets the visitors to Drumheller at the bridge.

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2. How were the Badlands and this deep valley formed?

Only during the last 500 million years have plants and animals produced hard parts capable of being fossilized. If you look at the Geological Time Chart you will find that dinosaurs were the dominant form of life during the 120 million years of the Mesozoic era comprising the Triassic, Jurassic and Cretaceous periods. This holds true on all the continents of the world. By the close of the Cretaceous the dinosaurs had been replaced by the mammals, and only in comparatively recent times did man appear upon this earth.

Now its easy to see that the dinosaurs were deeply buried beneath the deposits of the following Cenozoic era, and with the exception of a few places in the world this holds true. The Valley of the Red Deer River is one of these exceptions. During the Great Ice Age this part of Alberta was heavily glaciated, which is to say, the advance of the glacial ice cut away the Cenozoic deposits; leaving the rocks of the late Cretaceous almost at the surface. As the ice melted, the water was added to the drainage flow from the mountains to the west, and this flow cut its way through the soft sediments in which the dinosaurs lie buried. Thus the exposures were created and our fossil wealth made easily accessible. Because these sedimentary rocks are soft they are easily cut and shaped by the sculpturing action of water, wind and frost. So it can be said that erosion shaped these Badlands as you see them and will continue to do so.

The Valley walls in the vicinity of Drumheller are composed of alternate bands of black, brown, grey and white layers of coal, ironstone, clay, shale and sandstone. These rocks are called the Edmonton formation by geologists and the fossils they contain tell us that they date from near the end of the Cretaceous period.

Sometimes we are asked, "Have the dinosaurs all been found?" Quite obviously the answer is "no." As erosion continues its slow progress into the Edmonton beds more fossils will be exposed. Each new exposure may be a prospect leading to a new discovery.

Quite recently a partially exposed skull was found by members of the Museum Society. It was professionally excavated, collected and brought into the museum for safe keeping. It was subsequently identified by Dr. Wann Langston, Jr., of the National Museum as the skull of a *Pachyrhinosaurus Canadensis*, a type of horned dinosaur never before found in the Edmonton beds. Because of its scientific significance it has been released by our Museum for study and reconstruction at the National Museum at Ottawa.

Had the skull remained exposed to the weather it would have eventually disintegrated and been lost. Had an enthusiastic rock hound found it and chipped away fragments, it would have been ruined, and a page in the geology of the Edmonton beds would have remained unturned.

We well know that with so many thousands of Badlands visitors roaming these hills and coulees in search of petrified bone and wood as souvenirs or as raw material for their lapidary work, there is some confusion as to what may be picked up and kept. The pieces that have eroded out of their original position and are lying scattered at the base of the cliffs or in dry washes where they have been carried by run-off are of no value scientifically but are highly prized by the finder. But if you should find an exposure of bone obviously lying in its original rock bed **DO NOT TRY TO DIG IT OUT. MARK THE SPOT AND PLEASE REPORT IT TO THE MUSEUM.** We will have the location thoroughly investigated. Your name will be recorded as having made the find and your co-operation will be greatly appreciated.

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EARLY DISCOVERIES OF DINOSAURS

From Natural History Paper No. 21—National Museum of Canada

By DR. CHARLES M. STERNBERG

The first scientific description of a dinosaur, "Notice on the Megalosaurus, the Great Fossil Lizard of Stonesfield," was read by William Buckland before the Geological Society of London on February 20th, 1824. No specific name was proposed, but there was a good description with illustrations. It was recognized as a reptile, though, of course, the name dinosaur had not yet been coined.

In 1800 Pliny Moody of South Hadley, Mass., collected a piece of flagstone on which was impressed a dinosaur track. This was exhibited as the track of Noah's raven. In 1836 a description of dinosaur tracks was published under the name Ornithichnites, which at that time were regarded as the tracks of birds.

In 1842 Sir Richard Owen, the greatest of the early English students of dinosaurs coined the name 'Dinosauria' for an order of reptiles. This word became anglicized to dinosaur, and today it has acquired an established place in our language.

The beginning of true scientific description of dinosaurs dates in North America at least, from Dr. J. Leidy's published descriptions of dinosaur bones from Montana in 1856.

Dinosaur discoveries in western Canada and Alberta were as follows:

1874—G. M. Dawson, acting as geologist on the International Boundary Survey along the Forty-ninth Parallel, collected dinosaur bones from badland exposures on the southern edge of Wood Mountain Plateau in Saskatchewan and along Milk River in Alberta.

1881—G. M. Dawson and his assistant, R. G. McConnell, discovered dinosaurs at several localities in southern Alberta, and McConnell collected dinosaur bones from Scabby Butte, north-west of Lethbridge for the Geological Survey Museum at Ottawa.

1884—J. B. Tyrrell observed many dinosaur bones in the Edmonton formation, along Red Deer River, and collected the first dinosaur skull in Canada from Knee Hills Creek.

1888—T. C. Weston, of the Geological Survey of Canada staff, made a trip down Red Deer River from the town of Red Deer to the mouth of the river. On this trip he collected a second carnivorous dinosaur skull from the Edmonton formation and reported on the extensive badlands exposure below the mouth of Berry Creek (Steveville).

1897-98 and 1901—The first systematic collecting of dinosaurs, by a palaeontologist, in Alberta was carried on by L. M. Lambe on Red Deer River below the mouth of Berry Creek.

1910—The first collection of articulated skeletons and large skulls of dinosaurs from Alberta was begun by Barnum Brown for the American Museum of Natural History

1912—The Stenberg family followed Brown and collected many skeletons and skulls from the Edmonton and Old Man formations of Alberta.

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Out of the past—and into the present—come the men who arrived here on horseback—and stayed to conquer the west. And they did it without the support of the military. The only protection they had against the Indians was a small detachment of North West Mounted Police. These are the men depicted in the Horseman's Hall of Fame.

These are the quiet men—who found the land they wanted, then set about making it their own. The names sound like a clarion call—John Ware, negro and first-class rancher; Jerry Potts, Indian interpreter; Chief Crowfoot, Indian Statesman; Colonel James Macleod, Commissioner of the North West Mounted Police. These men learned to live together with increasing understanding and with mutual respect.

Early this year two new exhibits were added to the Horseman's Hall of Fame, which are of particular interest because they deal with the Calgary Exhibition and Stampede. One shows Guy Weadick—originator of the Stampede—making his suggestion to the Big Four to underwrite the cost of the first Stampede in 1912. The scene is set in the lobby of the famous old Alberta Hotel, which boasted the longest bar west of Winnipeg. The Big Four shown are Pat Burns, A. E. Cross, A. J. MacLean and George Lane.

The second display shows replicas of three famous Canadian cowboys: The late Clem Gardiner of Pirmez Creek who earned the title of best all-round Cowboy at the first Stampede; the late Pete Knight of Crossfield, one of North America's all-time "greats" of rodeo riding; and Dick Cosgrave of Rosebud, Alberta—rancher and ten times world chuckwagon race champion — now Arena Director of the Calgary Exhibition and Stampede.

The figures depicted are constructed out of papier mache—a medium that is quite difficult to work with—especially when the effect achieved is as realistic as this. The figures of John Ware, Charlie Russell, the well-known cowboy artist, and the central figures of the signing of the Blackfoot Treaty No. 7, are excellent examples of the artistry involved in the project. These figures, both Indian and white, are beautifully executed. Expressions on the faces—the hands, feet and other details are meticulously prepared by Mr. Julian West, creator of the figures.

One of the most striking exhibits in the Horseman's Hall of Fame is the beautifully expressed head of Chief Walking Buffalo. This Indian, still alive, is over ninety years of age. The nobility of the Indian has been carefully captured in this striking head. Other figures of interest are the Indian mother and two papooses—and a child, learning Indian crafts at her mother's knee.

There is a collection of early rifles and some hand guns. A large display of Charlie Russell prints is set up on a revolving "drum" and shows some of the most famous of Charlie Russell's paintings, watercolors and black-and-white drawings. A bronze casting that has been valued at \$25,000 is another of the handsome displays well worth seeing.

New exhibits are constantly finding their way into the Horseman's Hall of Fame. A special committee has been delegated to choose candidates to the Hall from among the famous westerners known and respected during their lifetime for the part they played in opening the west for settlement.



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DRUMHELLER AND DISTRICT MUSEUM SOCIETY 1963 - 64

The Red Deer River Valley was called by Canadian artist A. Y. Jackson, "the most paintable valley in western Canada." Some consider its ravaged canyons and grotesquely regimented formations every bit as spectacular as the Grand Canyon. The fossil record found in these badlands has brought geologists and palaeontologists from all over the world to comb the ancient sedimentary deposits. The variety of dinosaur remains found in these Upper Cretaceous sediments is unsurpassed anywhere in the world.

In 1955 the Drumheller and District Museum Society was formed to tell the story of this valley. From 10,000 visitors in 1957 the attendance grew to over 50,000 in 1963. From a modest beginning the museum expanded by 1963 to include a mounted Duck-Billed dinosaur skeleton, *Edmontosaurus* and displays portraying the Geology of the Badlands, the Inland Sea, the Petrified Forest and Coal. Being added in 1964 are displays depicting Dinosaurs in general, Duck-Billed Dinosaurs, Horned Dinosaurs and Carnivorous Dinosaurs. A feature display will include the outstanding fossil collection of the late Wm. R. Fulton, Drumheller's most prominent fossil collector. Also being added are displays of early Mammals, the Ice Age, Buffalo and Indian Artefacts. In another display we are fortunate in having on view excellent specimens of the world famous Juniper Root Carvings of W. G. Hodgson of Dorothy, Alta.

From its inception the museum has been fortunate in the whole hearted financial support of the community. The public have also been most generous in making available objects for display. The museum in turn has provided the facilities for display, protection and preservation of objects that might otherwise be lost or destroyed.

The museum displays are designed to interpret the individuality and environment of the unique Drumheller area. The matter of interpretation has both cultural and educational connotations. In particular the museum stresses planned visits of school classes, which continue to increase year by year.

In cooperation with the Alberta Tourist Association, the Museum has become the centre for distribution of Tourist Information for the Drumheller area.

The Drumheller museum is akin to the prophet Ezekiel who spoke of being set down "in the midst of the valley; and it was full of bones—and lo, they were very dry." Ezekiel also said: "So I prophesied—and the bones came together, bone to its bone. And I beheld, and lo, there were sinews upon them, and flesh came up, and skin covered them above—and the breath came unto them and they lived." The museum has an abundance of dry bones and fossils which we are continually striving to display as a living story.

Financially, the improvement of our facilities depends entirely upon the donations of our visitors. PLEASE BE GENEROUS!



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BEGINNINGS OF GEOLOGY



As a form of life uniquely endowed with the capacity to perceive himself in relation to his environment, man has ever questioned his surroundings and their meanings.

From the idea of the river floods and the layers of sediment they leave behind, which was common knowledge, it was an easy inference that layered bedrock was also water-deposited. Finally to account for the immense thickness and extent of water deposited rocks it was suggested that the lands of the earth had repeatedly been submerged beneath the waters of a universal ocean. Materials in suspension in the water settle out and in time solidify into stone. Life that died and was covered in the sand and mud were entombed in the sediments to become the fossils we know today.

THE VEDAS, HINDU HYMNS dating from 1300 B.C. have such submergences as their chief theme.

IN 450 B.C. HERODOTUS noticed fossil shellfish deep in the Libyan desert and correctly inferred that the Mediterranean had once encroached far inland. It was thus realized that the submergences need not be world-wide, rather that they occurred at different places.

Although the idea of marine submergences and deposit of layered rocks was grasped so early progress was blocked by the church (Christian in Europe, Mohammedan in Asia). In the Middle Ages the church dominated the state. All learning and teaching that did not have its approval were prohibited. Curiously enough both the Bible and the Koran recognized Noah's flood as the one great catastrophe after creation, but would recognize no other geological changes.

OMAR KHAYYAM (about A.D. 1123), by profession an astronomer and mathematician, argued, on the basis of the layered rocks, that the sea had once covered the territory of Central Asia. This was contrary to the teaching of the Koran. He was requested to recant, to say that he was mistaken, or else be subject to dire punishment. As he would not do the first and did not want to suffer the second, he fled from Samarkand to exile in the desert and there wrote: A Book of Verses underneath the Bough, A Jug of Wine, a Loaf of Bread and Thou—Beside me singing in the wilderness—Oh, Wilderness were Paradise enow!

The champions of marine submergence, those who asserted down sinking and uplifting of lands areas below and above the level of the sea, maintained the correctness of their contentions, because they said the traces of once living plants and animals were entombed in muds and sands which settled on bottoms of submerged areas, areas later becoming dry land by uplift. It took LEONARDO DA VINCI (A.D. 1519) a person of consequence, for he was an engineer, a scientist, a painter and writer to say this forthright and to persist in his affirmation. He had observed fossil sea shells in the layered rocks of northern Italy when he was making excavations for canals. As da Vinci could not be suppressed, the clergy took the opposite view, that the fossils were special creations, things God had tried, but found unsuitable and had therefore buried in the rocks. These conflicting interpretations were fiercely argued for the next 200 years. Fossils were finally recognized as the record of ancient organisms, and the second great idea of geology was established.

Modern Geology and Paleontology have progressed rapidly in only the last 100 years. Since 1776 we have realized that rock beds could be co-related over widely separated areas by means of fossils.

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WHAT ARE FOSSILS?



Fossils are the remains or indications of life preserved from prehistoric time.

The word "fossil" is derived from the Latin 'fossilis', meaning something dug out of the earth.

TYPES OF FOSSILIZATION FOUND AT DRUMHELLER

1. **PETRIFICATION** — Such fossils are said to be petrified (Latin *petra*, 'stone' and *facere*, 'to make'). Literally, this means turned to stone.

This change may be accomplished in the following ways:

1. **PERMINERALIZATION**—Mineral matter from underground water fills up all the voids without altering the original structure. This may occur in bones and many kinds of shells.

2. **REPLACEMENT**—Organic substances such as shells, bones, wood, etc., become converted into stone by the gradual replacement of their structure, particle by particle with infiltrated water borne mineral matter. The outward form and minutest structural details are exactly preserved. The common infiltrating minerals are calcite, silica and iron pyrite. This is the common process in petrified wood and many dinosaur bones.

3. **DISTILLATION**—The volatile elements of organic material may be distilled away, leaving a residue of carbon to record the form of life. Leaves are generally preserved in this way, more rarely animal parts.

II—**MOLDS, CASTS AND IMPRINTS**—Shells or other organic structures may be dissolved by percolating ground water, leaving an open space that preserves the form of the object. This hole is a natural **MOLD**.

Percolating subsurface water may fill such holes with mineral substance, thus producing **NATURAL CASTS**.

The molds of thin objects like leaves are commonly spoken of as **IM-PRINTS**.

Hollow objects may in addition, have an internal mold or core.

III—**FOOTPRINTS AND TRAILS**—They may supplement other fossils or be the only record of some forms of life. Fossil worm burrows are another example.

IV—**COPROLITES**—Fossilized fecal excrement. They are of significance when associated with skeletal remains in throwing light on the food and feeding habits of the animal in question.

V—**GASTROLITHS**—These were gizzard stones of herbivorous dinosaurs. Like chickens who have pebbles in their crops as aids to grinding up food, dinosaurs used larger stones for the same purpose.

(III, IV & V are regarded by some as indirect fossils).

CONDITIONS FAVOURING FOSSILIZATION

1. **HARD PARTS** such as bones and shells are most frequently petrified.

2. The organism must be buried quickly in some protecting medium. If not buried immediately animals are destroyed by scavengers, bacterial decay (putrefaction) and weathering. Burial by moist sediments in swamps, rivers or sea and lake bottoms favour fossilization processes.

Only a small part of the organisms existing at any one time are likely to be preserved as fossils. Only an insignificant number of those preserved are available. Many are hundreds or thousands of feet below the sea and earth surface. Thus our knowledge of ancient life is incomplete. As Huxley has said, "Many paragraphs, some chapters, and a few whole volumes are missing from the record of life on earth."

"Race after race resigned their fleeting breath—

The rocks alone their curious annals save."

—T. H. Conrad.

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PLEASE NOTE!

YOU FIND A LARGE OR UNUSUAL FOSSIL:

ULARLY—

in place in jaw bones.

pe of skull.

articulated (jointed) bones.

one extending into the rock or hillside.

NOT REMOVE THEM.

NOT DIG THEM OUT.

NOT TAKE AWAY PIECES.

PLEASE report such finds to The Drombeller District Museum Society (i.e. Dinosaur Fossils Museum on 1st St. E.). These are extremely valuable and rare specimens of scientific interest, and must not be destroyed.

cooperation helps this and other museums interpret the story of the past and to preserve it for the future and the benefit of

FOSSIL HUNTERS and ROCK HOUNDS

PLEASE NOTE!

**WHEN YOU FIND A LARGE OR UNUSUAL
FOSSIL:**

PARTICULARLY—

Teeth in place in jaw bones.

Any type of skull.

Large articulated (jointed) bones.

Any bone extending into the rock or hillside.

THEN—

- 1. DO NOT REMOVE THEM.
DO NOT DIG THEM OUT.
DO NOT TAKE AWAY PIECES.**
- 2. PLEASE report such finds to The Drumheller
and District Museum Society (i.e. Dinosaur
& Fossils Museum on 1st St. E.). These are
frequently valuable and rare specimens of
great scientific interest, and must not be dis-
turbed.**

Your cooperation helps this and other mu-
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